

WHAT IS CLAIMED IS:

1           1.     A ballistic magnetoresistive sensor, comprising:  
2           a first pinned layer;  
3           a first free layer;  
4           a nickel nano-contact layer disposed between the pinned layer and the free layer;  
5     and  
6           a first and second lead layer disposed proximate to the pinned layer and free layer  
7     respectively for providing a sense current that flows perpendicular to the planes of the  
8     layers.

1           2.     The ballistic magnetoresistive sensor of claim 1 further comprising layers  
2     of tantalum disposed between the pinned layer and between the first lead and the free  
3     layer and the second lead.

1           3.     The ballistic magnetoresistive sensor of claim 1, wherein the first pinned  
2     layer, first free layer, nickel nano-contact layer and first and second lead layers form a  
3     nano-contact region.

1           4.     The ballistic magnetoresistive sensor of claim 1 further comprising outside  
2 structures disposed on opposite sides of the nano-contact region, the outside structures  
3 comprising a second and third pinned layer, a second and third free layer, a first and  
4 second insulation layer disposed between the second pinned layer and the second free  
5 layer and between the third pinned layer and the third free layer, and outside lead layers  
6 disposed proximate to the second and third pinned layers and the second and third free  
7 layer.

1           5.     The ballistic magnetoresistive sensor of claim 4, wherein the pinned layers  
2 comprise a layer of nickel and a layer of cobalt iron (CoFe).

1           6.     The ballistic magnetoresistive sensor of claim 4, wherein the free layers  
2 comprise a layer of nickel iron (NiFe).

1           7.     The ballistic magnetoresistive sensor of claim 1 further comprising layers  
2 of tantalum disposed between the second pinned layer and one of the outside lead layers,  
3 between the third pinned layer and one of the outside lead layers, between the second free  
4 layer and one of the outside lead layers, and between the third pinned layer and one of the  
5 outside lead layers.

1           8.     The ballistic magnetoresistive sensor of claim 1, wherein the pinned layer  
2 comprises a layer of nickel and a layer of cobalt iron (CoFe).

1           9.     The ballistic magnetoresistive sensor of claim 1, wherein the free layer  
2 comprises a layer of nickel iron (NiFe).

1           10.    A magnetic storage device, comprising:  
2           at least one magnetic storage medium;  
3           a motor for moving the at least one magnetic storage medium;  
4           a ballistic magnetoresistive sensor for reading data on the at least one magnetic  
5 storage medium, and  
6           an actuator assembly, coupled to the ballistic magnetoresistive sensor, for moving  
7 the ballistic magnetoresistive sensor relative to the at least one magnetic storage medium,  
8 the ballistic magnetoresistive sensor further comprising:  
9                 a first pinned layer;  
10                a first free layer;  
11                a nickel nano-contact layer disposed between the pinned layer and the free  
12 layer; and  
13                a first and second lead layer disposed proximate to the pinned layer and  
14 free layer respectively for providing a sense current that flows perpendicular to the planes  
15 of the layers.

1           11.    The magnetic storage device of claim 10 further comprising layers of  
2 tantalum disposed between the pinned layer and the first lead and between the free layer  
3 and the second lead.

1           12.     The magnetic storage device of claim 10, wherein the first pinned layer,  
2     first free layer, nickel nano-contact layer and first and second lead layers form a nano-  
3     contact region.

1           13.     The magnetic storage device of claim 10 further comprising outside  
2     structures disposed on opposite sides of the nano-contact region, the outside structures  
3     comprising a second and third pinned layer, a second and third free layer, a first and  
4     second insulation layer disposed between the second pinned layer and the second free  
5     layer and between the third pinned layer and the third free layer, and outside lead layers  
6     disposed proximate to the second and third pinned layers and the second and third free  
7     layer.

1           14.     The magnetic storage device of claim 13, wherein the pinned layers  
2     comprise a layer of nickel and a layer of cobalt iron (CoFe).

1           15.     The magnetic storage device of claim 13, wherein the free layers comprise  
2     a layer of nickel iron (NiFe).

1           16.     The magnetic storage device of claim 10 further comprising layers of  
2     tantalum disposed between the second pinned layer and one of the outside lead layers,  
3     between the third pinned layer and one of the outside lead layers, between the second free  
4     layer and one of the outside lead layers, and between the third pinned layer and one of the  
5     outside lead layers.

1           17.    The magnetic storage device of claim 10, wherein the pinned layer  
2   comprises a layer of nickel and a layer of cobalt iron (CoFe).

1           18.    The magnetic storage device of claim 10, wherein the free layer comprises  
2   a layer of nickel iron (NiFe).

1           19.    A method for forming a ballistic magnetoresistive sensor, comprising:  
2       forming a first free layer;  
3       a nickel nano-contact layer disposed between the pinned layer and the free layer;  
4       forming a first pinned layer; and  
5       forming a first and second lead layer disposed proximate to the pinned layer and  
6   free layer respectively for providing a sense current that flows perpendicular to the planes  
7   of the layers.

1           20.    The method of claim 19 further comprising forming layers of tantalum  
2   between the pinned layer and the first lead and between the free layer and the second  
3   lead.

1           21.    The method of claim 19, wherein the forming the first pinned layer, first  
2   free layer, nickel nano-contact layer and first and second lead layers further comprises  
3   forming a nano-contact region.

1           22.     The method of claim 19 further comprising:  
2           forming outside structures disposed on opposite sides of the nano-contact region,  
3     the forming the outside structures further comprising forming a second and third pinned  
4     layer, forming a second and third free layer, forming a first and second insulation layer  
5     disposed between the second pinned layer and the second free layer and between the third  
6     pinned layer and the third free layer; and  
7           forming outside lead layers disposed proximate to the second and third pinned  
8     layers and the second and third free layer.

1           23.     The method of claim 22, wherein the forming the pinned layers further  
2     comprise forming a layer of nickel and a layer of cobalt iron (CoFe).

1           24.     The method of claim 22, wherein the forming the free layers further  
2     comprise forming a layer of nickel iron (NiFe).

1           25.     The method of claim 19 further comprising forming layers of tantalum  
2     between the second pinned layer and one of the outside lead layers, between the third  
3     pinned layer and one of the outside lead layers, between the second free layer and one of  
4     the outside lead layers, and between the third pinned layer and one of the outside lead  
5     layers.

1           26.     The method of claim 19, wherein the forming the pinned layer comprises  
2     forming a layer of nickel and a layer of cobalt iron (CoFe).

1           27.     The method of claim 19, wherein the forming the free layer comprises  
2     forming a layer of nickel iron (NiFe).

1           28.     A ballistic magnetoresistive sensor, comprising:  
2           means for providing a pinned layer;  
3           means for providing a free layer;  
4           means for providing a nickel nano-contact layer disposed between the means for  
5     providing a pinned layer and the means for providing a free layer; and  
6           means for providing a first and second lead layer disposed proximate to the means  
7     for providing the pinned layer and free layer respectively, the means for providing a first  
8     and second lead layer providing a sense current that flows perpendicular to the planes of  
9     the layers.

1        29.    A magnetic storage device, comprising:  
2        means for recording magnetic data thereon;  
3        means for moving the means for recording magnetic data;  
4        means for reading data on the means for recording magnetic data; and  
5        means, coupled to the means for reading, for moving the means for reading  
6 relative to the means for storing data, the means for reading further comprising:  
7                means for providing a pinned layer;  
8                means for providing a free layer;  
9                means for providing a nickel nano-contact layer disposed between the  
10 means for providing a pinned layer and the means for providing a free layer; and  
11                means for providing a first and second lead layer disposed proximate to  
12 the means for providing the pinned layer and free layer respectively, the means for  
13 providing a first and second lead layer providing a sense current that flows perpendicular  
14 to the planes of the layers.